Real-time Coseismic Slip Estimation via the GNSS Carrier Phase to Fault Slip Approach: Potential Contribution for Redundant Tsunami Forecast system

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We demonstrate the feasibility of alternative method for GNSS based deformation monitoring suggested by Cervelli et al. [2002], which estimates fault slip directly from GNSS carrier phase without doing conventional positioning analysis. It should largely reduce computational cost. Additionally, their method (hereafter **PTS** (Phase To Slip)) may not require high quality orbit information, because it only uses change of azimuthal site-to-satellite range. However, there have been no following researches about PTS method since its development. Thus, to validate performance of PTS, we applied this method to the mainshock of the 2016 Kumamoto earthquake, with adding some modification to its original algorithm. We tried using both IGS final and broadcast for the information of satellite position.

As a result, we successfully obtained reasonable coseismic slip distribution compared to previous researches, both in the case of using IGS and broadcast. Broadcast-based result is shown in Figure 1. The maximum slip reached ~5.8 m, which was mainly concentrated on the shallow part of northeastern side of the fault. The total moment of the two faults was M_w7.08. These results are consistent with the source models estimated by previous researches such as Yarai et al. [2016]. Calculated surface displacement field also well agreed with estimation by kinematic PPP. Overall, results by IGS and broadcast became very similar.

From these results, we knew it is possible to detect coseismic slip by PTS with high certainty even if we use broadcast orbit, which can be acquired by GNSS receiver in real time. It suggests PTS method can play an important role for redundant estimation of coseismic slip, with lower computational cost and no any other dependence on external information. It can lead us to obtain initial tsunami source model as deformation of ocean bottom. In the presentation, we will discuss about potential contribution of PTS method for tsunami forecast, through the case of its application to interplate large earthquake. We will also explain about the principle of PTS method.

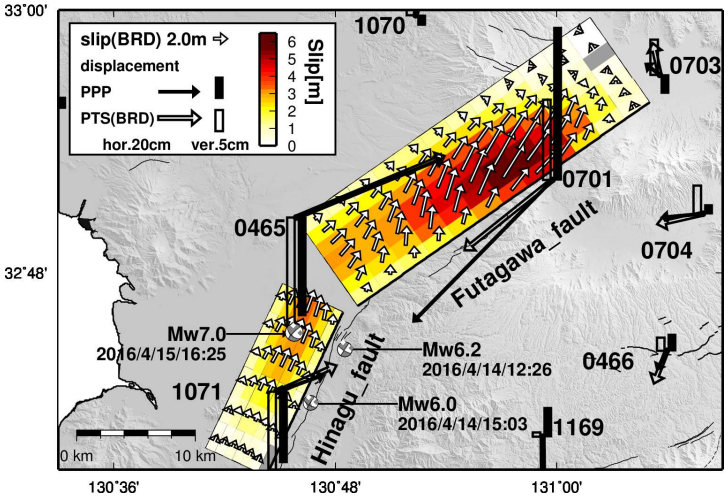

Figure 1. Slip distribution of the mainshock of the 2016 Kumamoto earthquake, estimated by PTS. White arrows represent the direction and norm of slip. The slip amount of each sub-fault also is indicated by the color. If the slip norm became smaller than the estimated uncertainty, the sub-fault was masked in gray.